Welcome to
NASA Applied Remote Sensing Training Program (ARSET)
Webinar Series

Introduction to Remote Sensing Data for Land Management

Course Dates: Every Tuesday, May 20-June 17
Time: 12-1PM EDT

ARSET

Applied Remote SEnsing Training

A project of NASA Applied Sciences

Important Information

- Presentations URL:

  - Http://arset.gsfc.nasa.gov/webinars

- Contact for requesting recorded link for the webinars:

  - Marines Martins: marines.martins@ssaihq.com

- ARSET Land ListServ URL:

  - https://lists.nasa.gov/mailman/listinfo/nasa-water-training

- Homework update: I will send you a link to access a Google document.
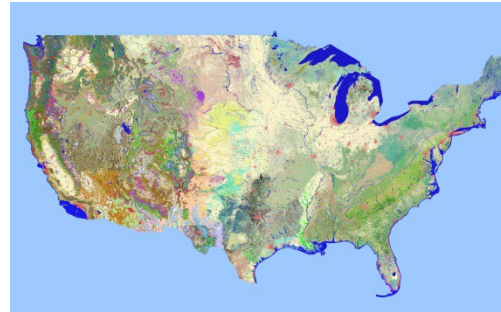
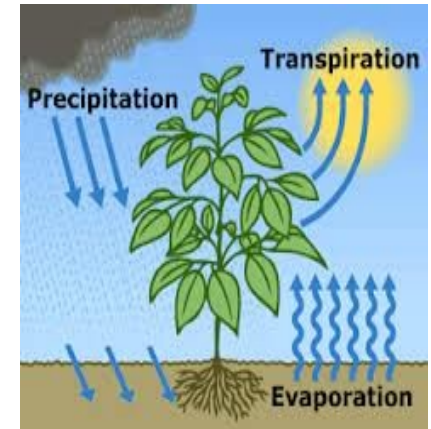# Course Outline

Week 1

Intro. & Background: Satellite Remote Sensing

Week 2

Land Cover Mapping/Web tools for data access

Week 3

Soil Moisture and Evapotranspiration

Week 4

Change Detection

Week 5

Web tools for data access/Importing data into GIS

ARSET Land Resource Management
http
://arset.gsfc.nasa.gov/eco/webinars/land-management

Course Instructors for Today

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- For more information about the ARSET program contact: Ana Prados aprados@umbc.edu

Outline

- Definition and applications

- Methods

- Where to obtain and visualize change detection datasets

- Live demo

Change Detection: Definitions and Applications

What is Change Detection?

- The comparison of information about an area on the earth over two or more points in time.

  ➢ Where and when has change taken place?

  ➢ How much change, and what type of change has occurred?
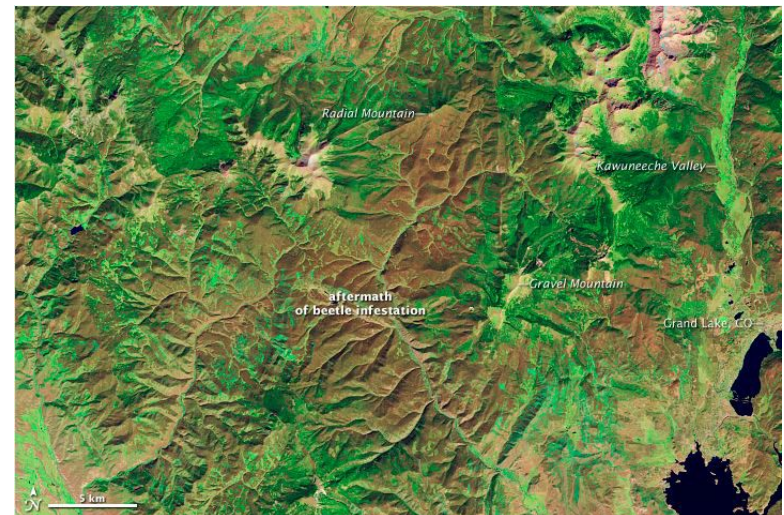
  ➢ What are the cycles and trends in the change?
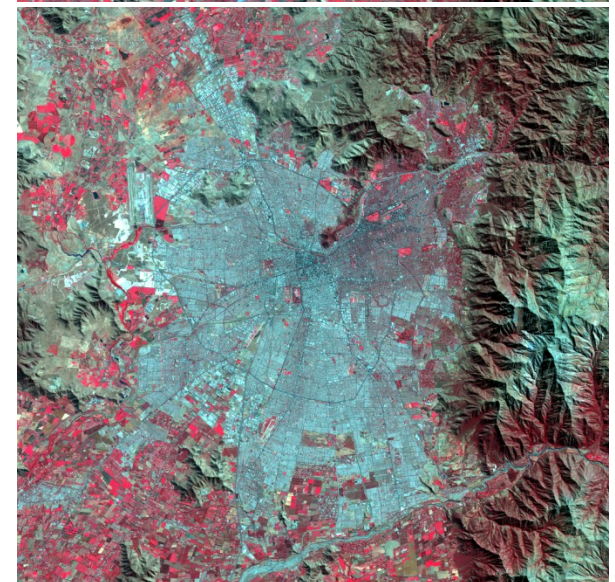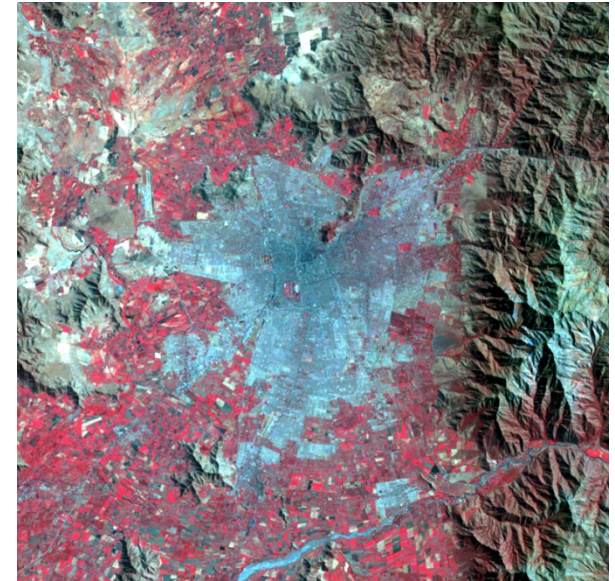
Santiago, Chile urban growth from 1975 to 2013 from Landsat
Source: earthshots.usgs.gov

Change Detection Applications

- Deforestation assessment

- Vegetation phenology

- Urban growth

- Forest disturbance assessment

- Crop stress detection

- Etc.....

Bark beetle infestation in Colorado between 2005 and 2011
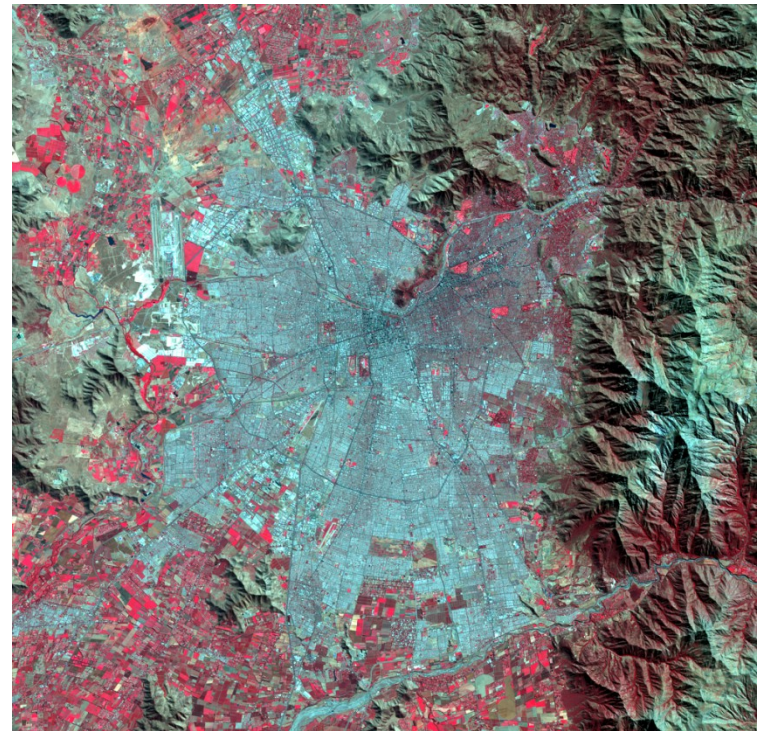
Source: earthobservatory.nasa.gov

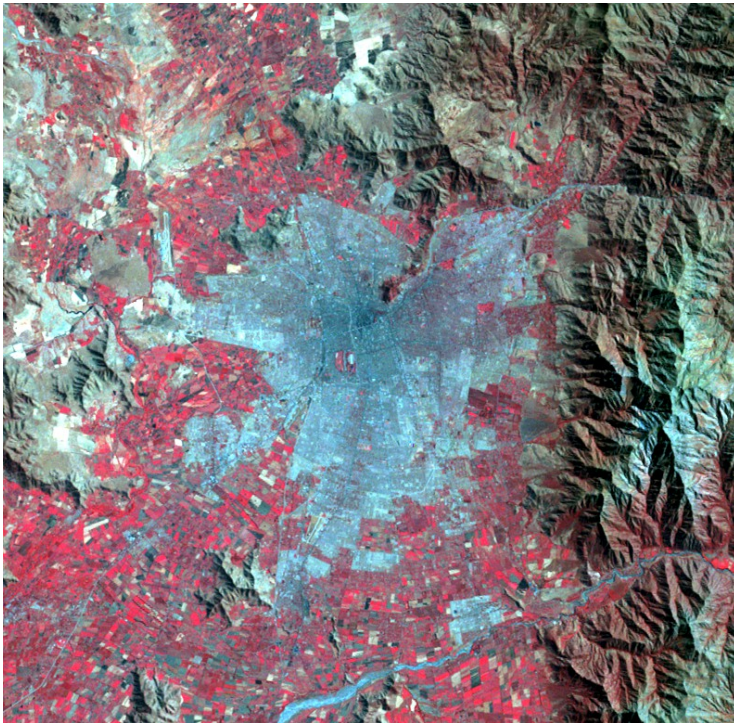# Change Detection Methods

Change Detection Methods

- Visual analysis

- Classification approaches

- Image Differencing

- New developments: Temporal trajectories

- NDVI time series

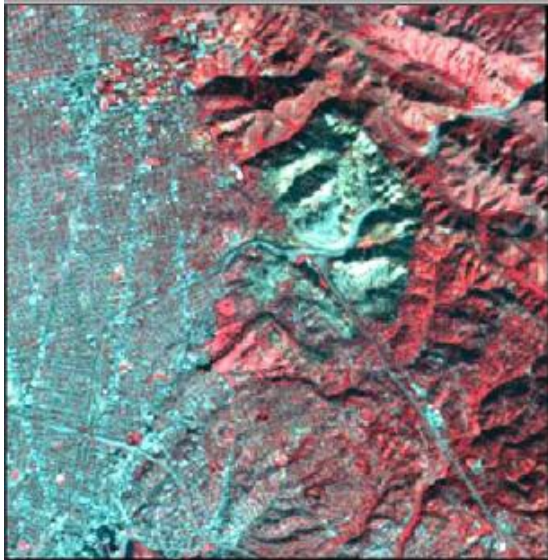# Change Detection: Visual Analysis

- Heads-up digitizing

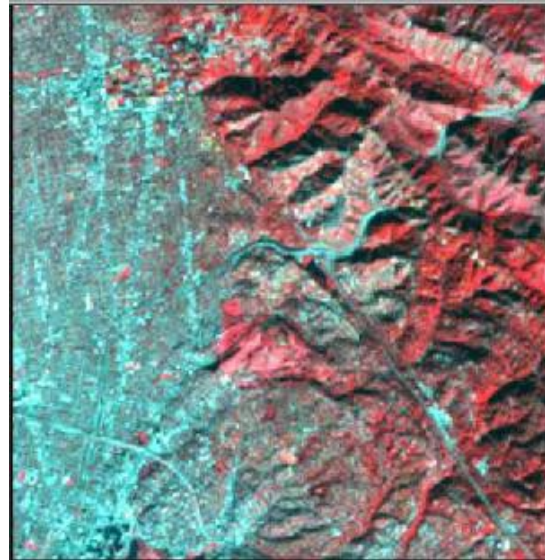- Need GIS or Image Processing software

Santiago, Chile urban growth from 1975 to 2013 from Landsat
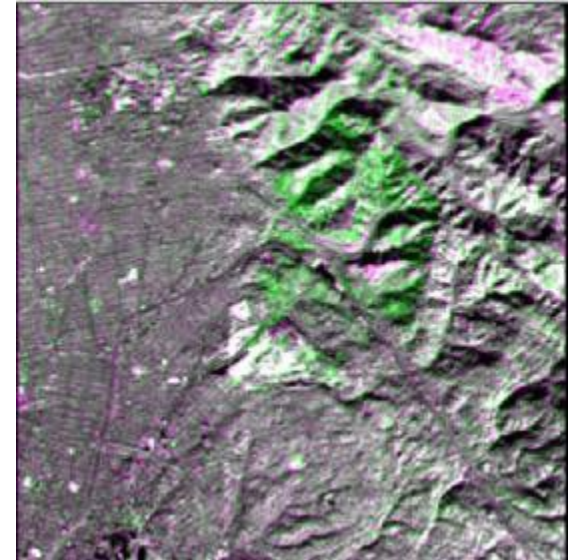*Source: earthshots.usgs.gov*

Change Detection: Visual Analysis

1991

1999

Change Image

Landsat images of vegetation regrowth after the Oakland fire

Change Detection: Visual Analysis

Using a GIS or image processing software……
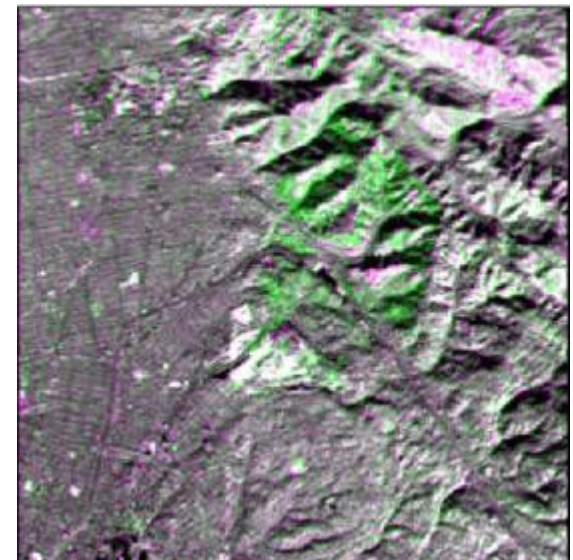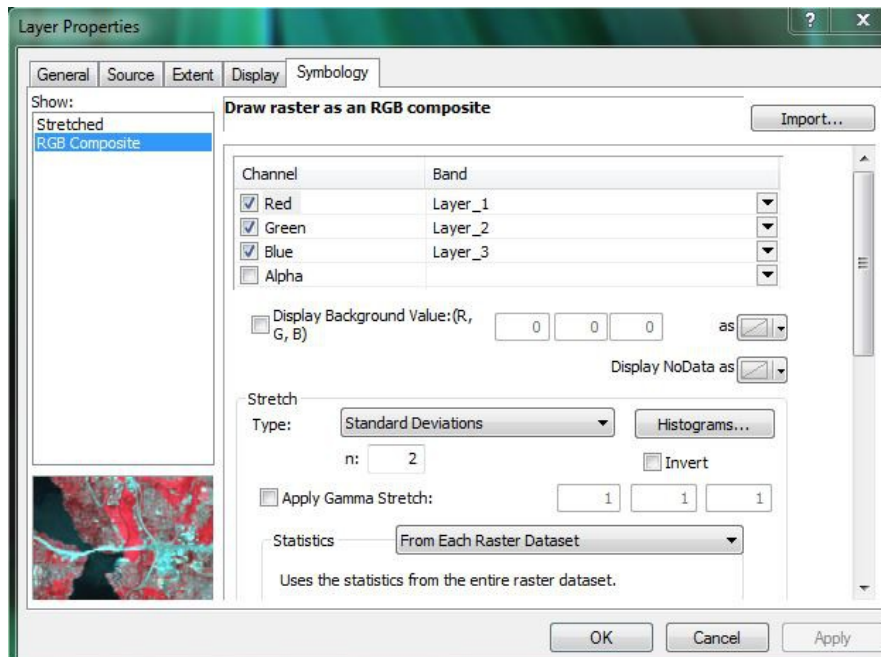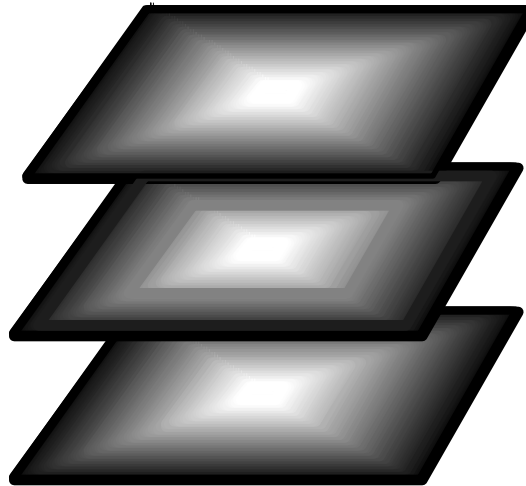
1991   **band 4 (NIR)**   **Red Channel**

1999   **band 4 (NIR)**   **Green Channel**

1991   **band 4 (NIR)**   **Blue Channel**

Change Detection: ArcGIS Change Matters
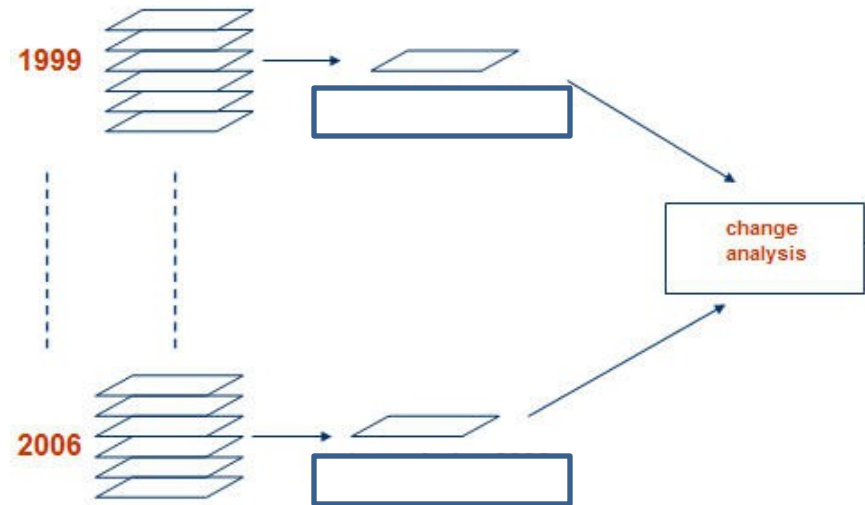## (www.esri.com/software/landsat-imagery/viewer)
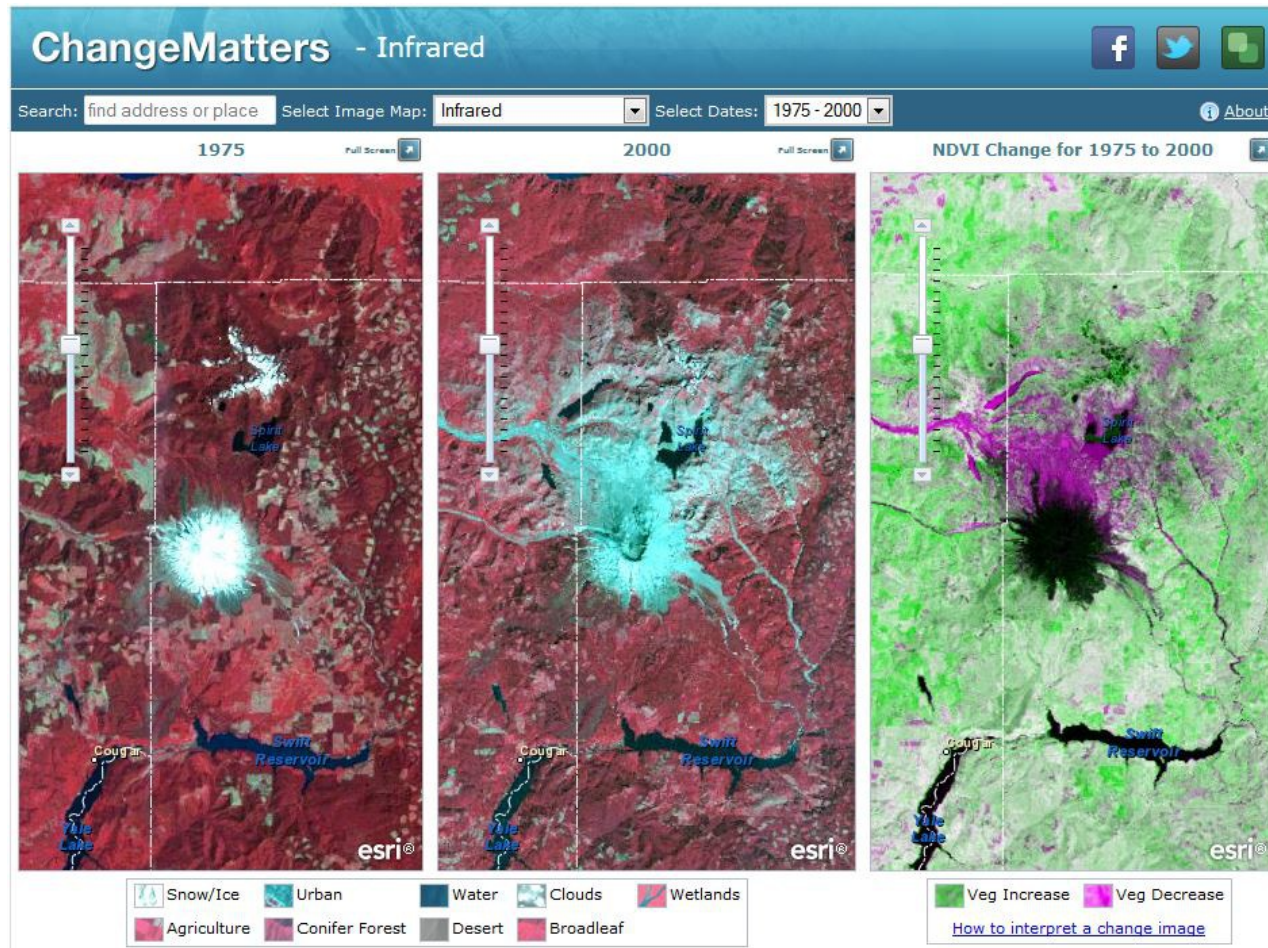
Change Detection: Traditional Methods

➢ Two dates of imagery (i.e. 5 to 10 years apart)

- Image subtraction

- Image classification

➢ Need:

- GIS or image processing software

- Ability to interpret change

- Precise registration of images

1999

2006

change analysis

Change Detection Methods: Recent Developments

- New methods (such as Landtrendr and Vegetation Change Tracker) take advantage of the entire Landsat archive (1985-current) by using an annual time series to look at changes/trends

- What comes from Landtrendr:

  - Magnitude of change: 1-100% tree cover loss

  - Duration: 1-25 years

  - Year of onset of disturbance
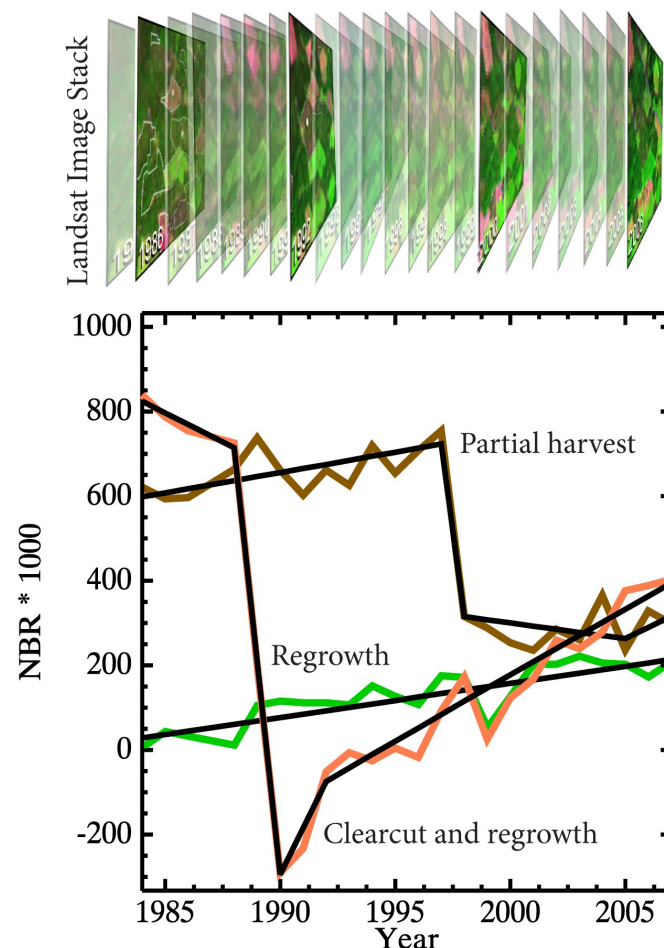
Kennedy, R., et al. (2010). Detecting trends in forest disturbance and recovery using early Landsat time series: 1. LandTrendr- Temporal segmentation algorithms. Remote sensing of Environment, 114, 2897-2910

Results of LandTrendr Processing:
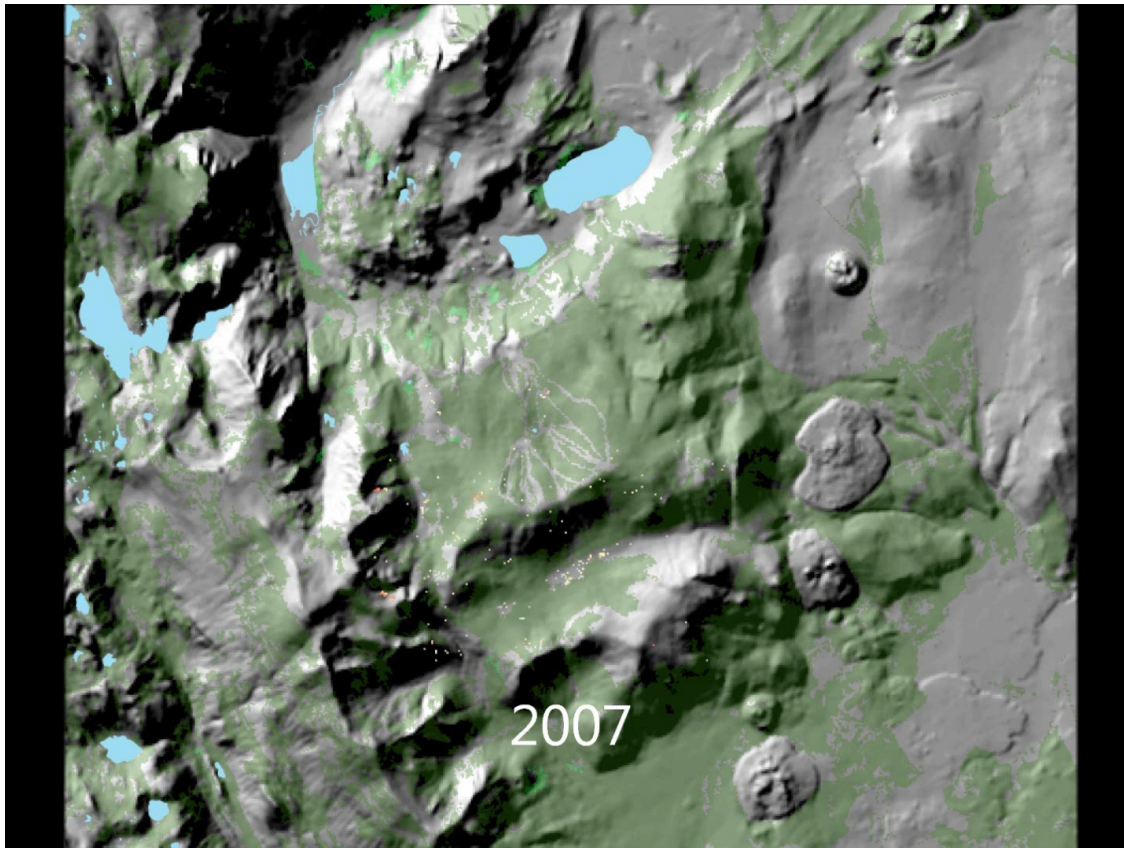# Forest Disturbance in California

1986
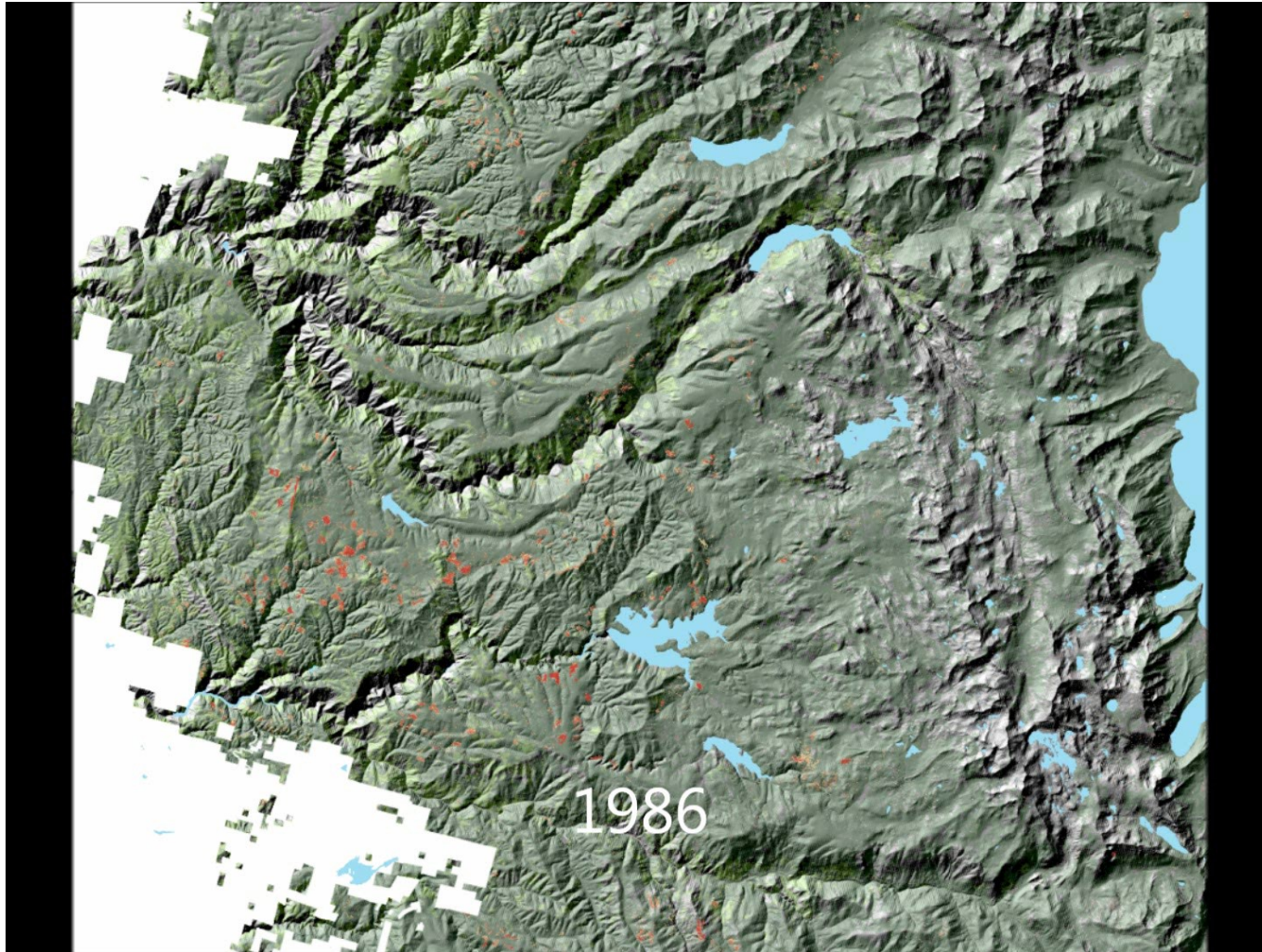
Tahoe and El Dorado National Forests, west of Lake Tahoe

Results of LandTrendr Processing:
Forest Disturbance in California

Animation demonstrates the temporal pattern of insect-caused mortality of Whitebark pine on June Mountain in the eastern Sierra Nevada, California
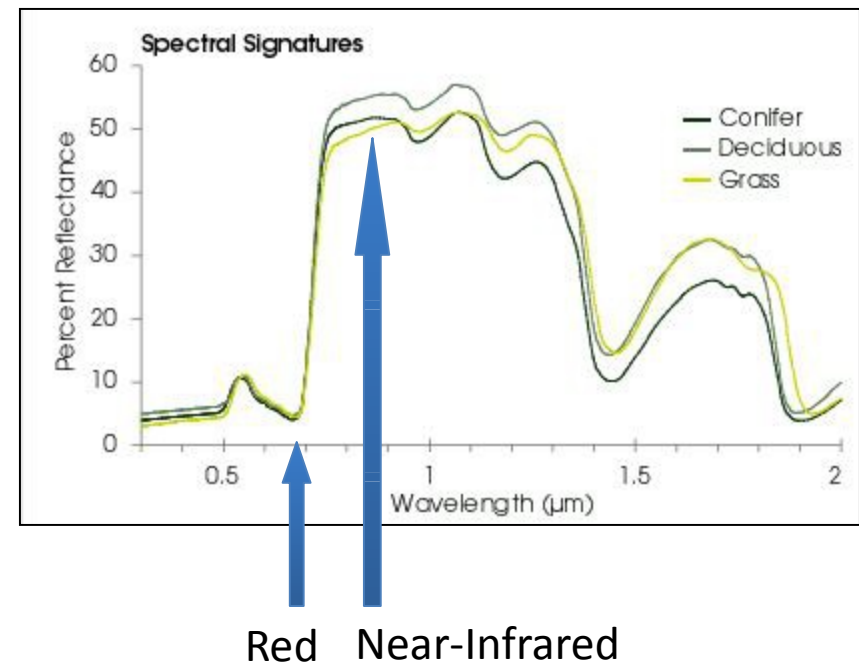

2007

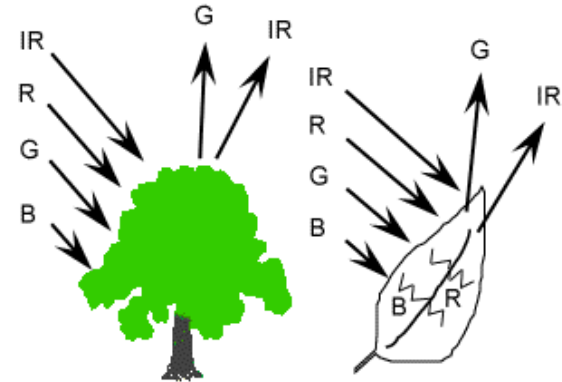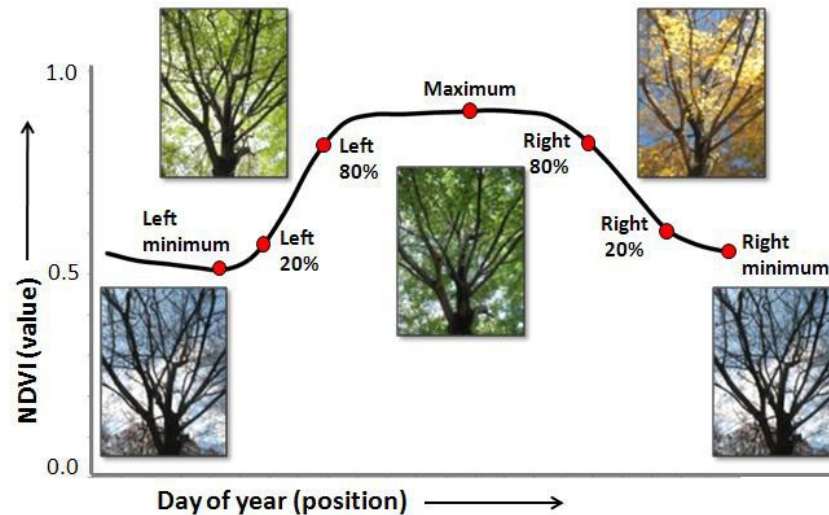# NDVI Time Series: Vegetation Index Refresher

- What is a vegetation index?

  – Based on the relationship between red and near-infrared wavelengths.

  – Chlorophyl strongly absorbs visible (red)

  – Plant structure strongly reflects near-infrared

Red   Near-Infrared

NDVI: Phenology

Phenology – Using remote sensing to track seasonal changes in vegetation

North America NDVI images in winter and summer

Source: spacegrant.montana.edu

NDVI: Drought monitoring

Areas affected by drought can be detected by calculating the difference in NDVI between a single year and a multi-year average

This is a September 2002 NDVI anomaly image for Africa. Brown areas represent areas where vegetation density is less than previously observed and the green represents where vegetation is more dense.
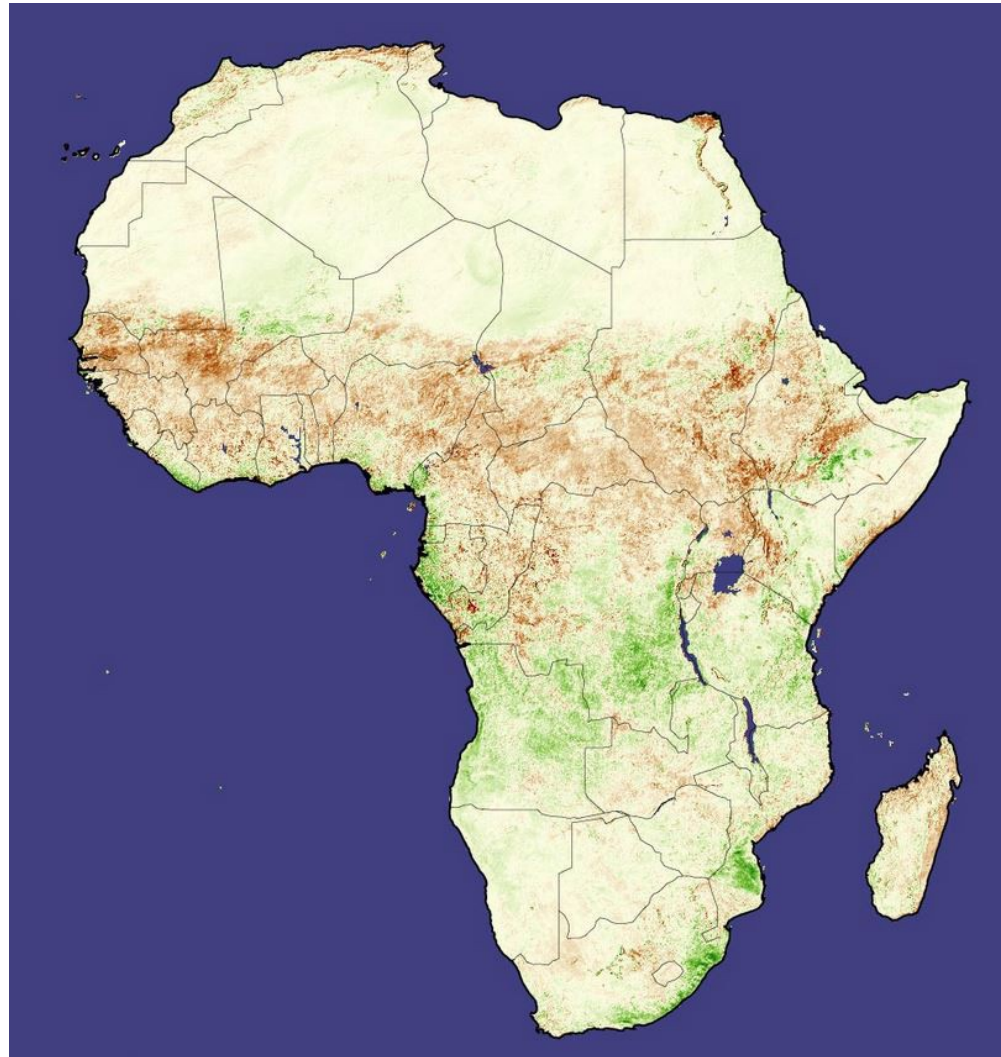
Credit: NASA MODIS

Where to Obtain and Visualize Change Detection Datasets

Datasets/Websites Used for Change Detection

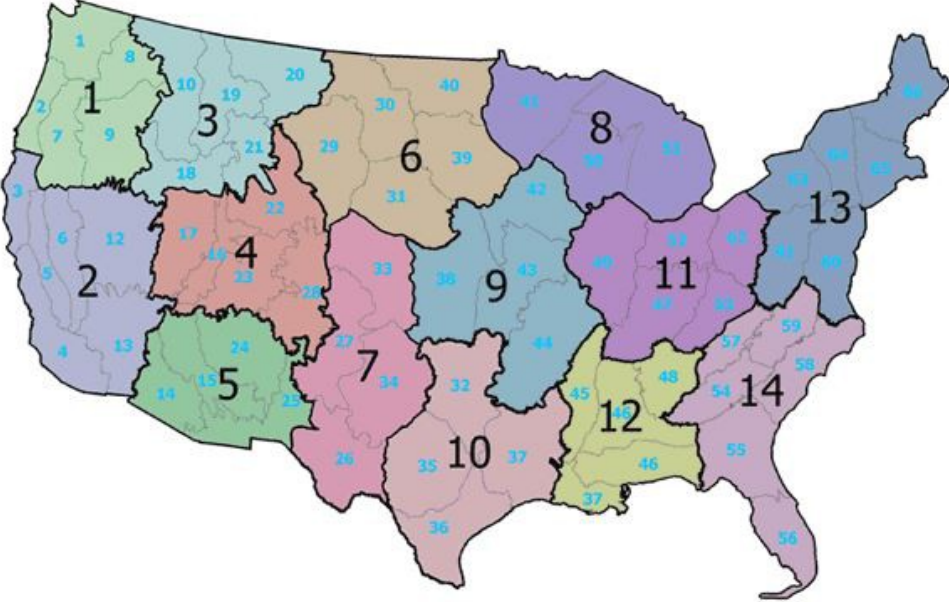|	Name	Dates	Image Source/Location	Spatial Resolution	Available Data	Extent
Data downloads	National Land Cover Database 2011 (USGS)	2001-2011	Landsat TM	30 m	Landcover, % impervious, % tree cover, landcover change	Conterminous U.S.
	North American Landscape Characterization (USGS)	1973,1986,1991 triplicates	Landsat MSS		MSS images	Conterminous U.S. and Mexico
	Vegetative Cover Conversion	2000-2010	MODIS (MOD44B)	250 m	Percent tree cover	Global
	Land Cover/Land Cover Change	2001-2012	MODIS (MCD12Q1)	500 m	Land cover type	Global
Web Viewers	Land Cover Dynamics	2001-2010	MODIS EVI (MCD12Q2)	500m	Timing of vegetation phenology	Global
	Forest Change Assessment Viewer	2000-2013	MODIS	500 m	Forest change, phenology	U.S.
	Global Forest Change (University of Maryland)	2000-2012	Landsat ETM+	30 m	Forest extent, loss and gain	Global
	Global Forest Watch (World Resources Institute)	2000-2012	Landsat ETM+	30 m	Forest extent, loss and gain plus forest use, protected areas, etc.	Global

National Land Cover Database (NLCD) Land Cover Change Product

National Land Cover Database (NLCD) Land Cover Change Product

- ➢ Land cover change between 1992 and 2001

- ➢ Pink areas represent changes
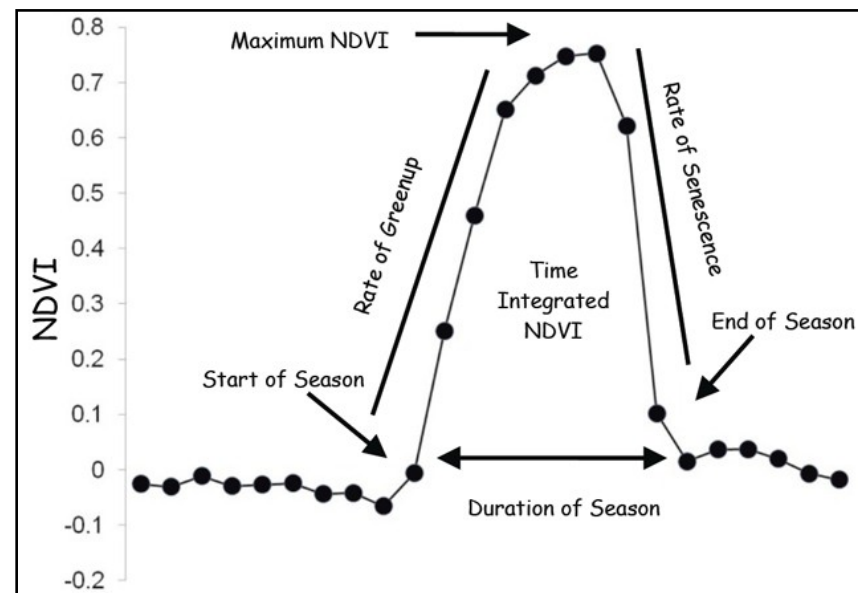
- ➢ Need a GIS to view and analyze
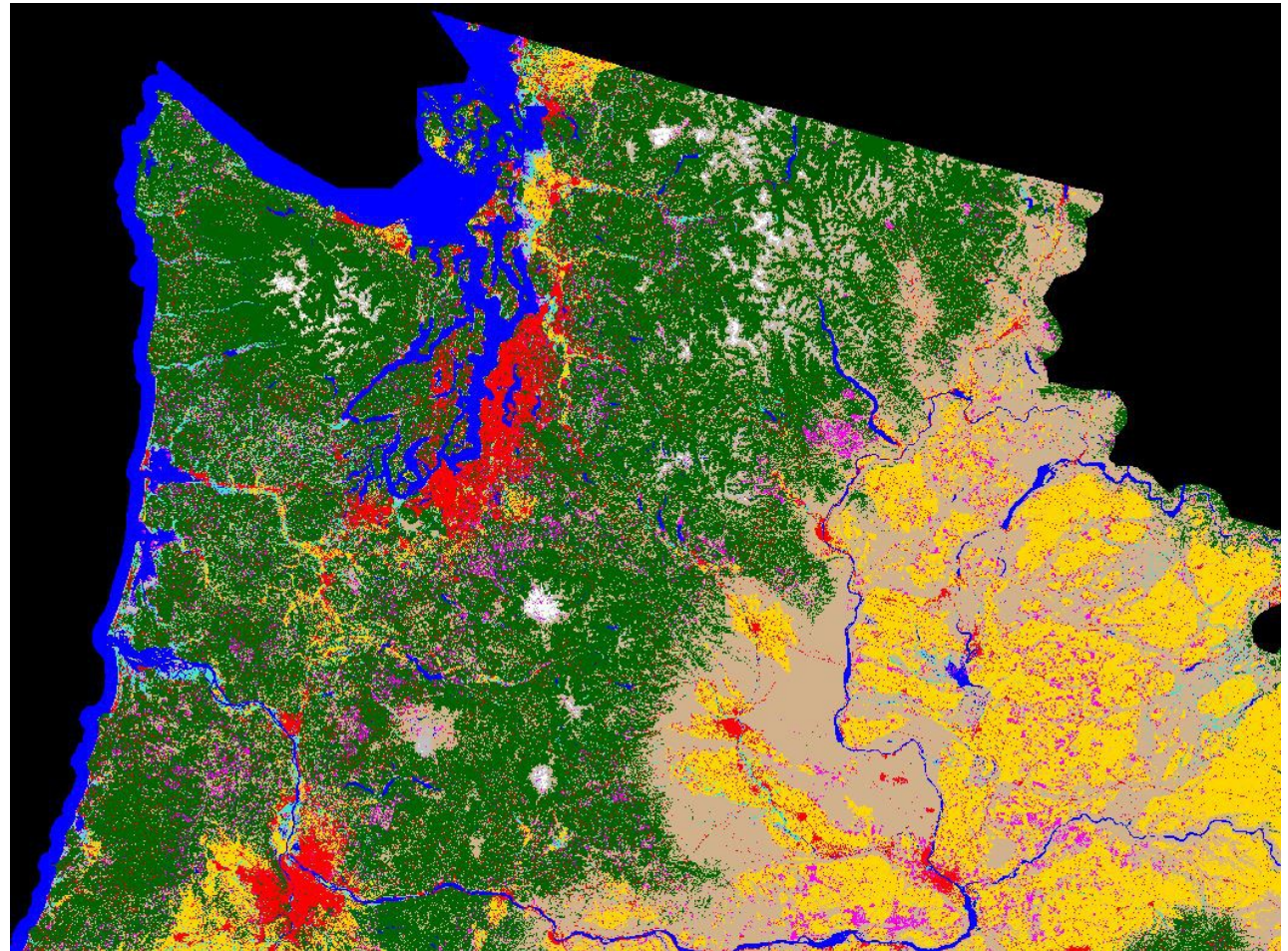
Land cover change in the Pacific Northwest

MODIS NDVI Phenology
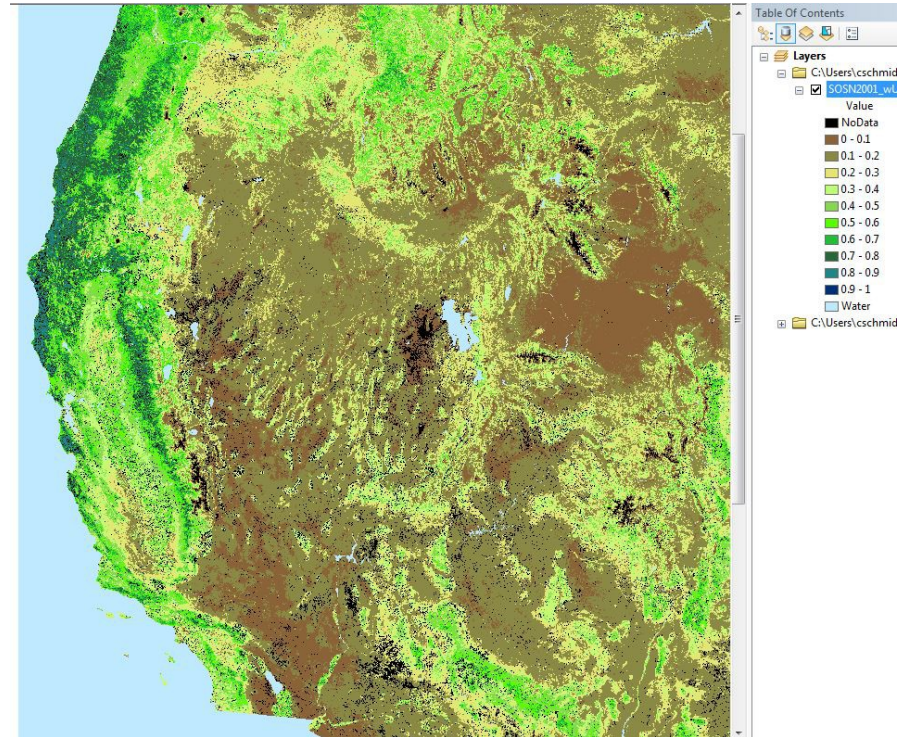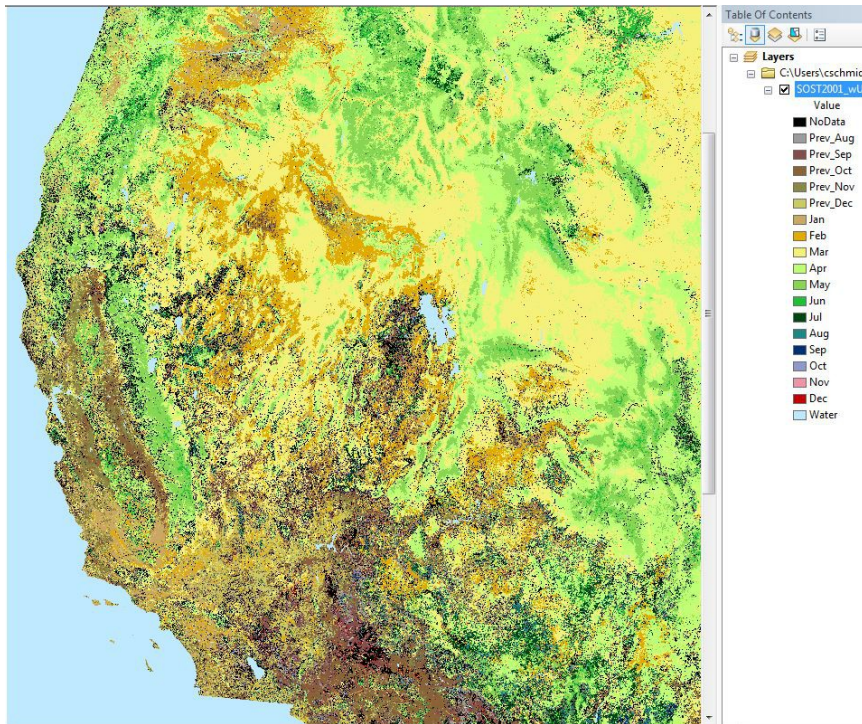## (USGS EROS Data Center: phenology.cr.usgs.gov)

- Available datasets for the United States: 2001-2012

  - Start of season time/NDVI

  - End of season time/NDVI

  - Time of Maximum NDVI

  - Length of growing season

  - Maximum increase in

MODIS NDVI Phenology

Start of Season timing and NDVI values for 2001

Need a GIS to visualize and analyze!

What is ForWarn?

- Satellite-based forest disturbance monitoring system for the U.S.

- New forest change products every 8-days

- Archived data for disturbance tracking since 2000

- Derived from MODIS

- Web-map service to visualize forest change: Forest Change Assessment Viewer

U.S. Forest Change Assessment Viewer (ForWarn)

Three types of products:

➢ Forest Change Products

➢ Basic Phenology Products

➢ Derivative Phenology Products

http://forwarn.forestthreats.org
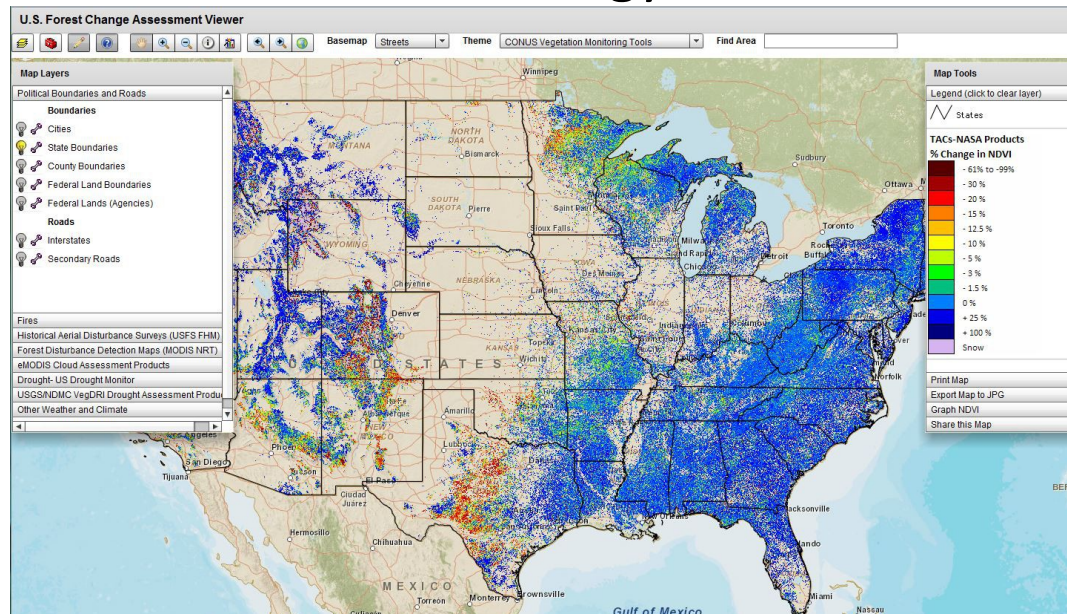
U.S. Forest Change Assessment Viewer: Forest Change Products

- ➢ Changes in NDVI produced year-round at 8-day intervals

- ➢ Each map shows the prevailing conditions (maximum greenness) compared to a similar 24-day time period during one of three possible baselines ("normals"):
  - The prior year
  - The last 3 years
  - The full period of record
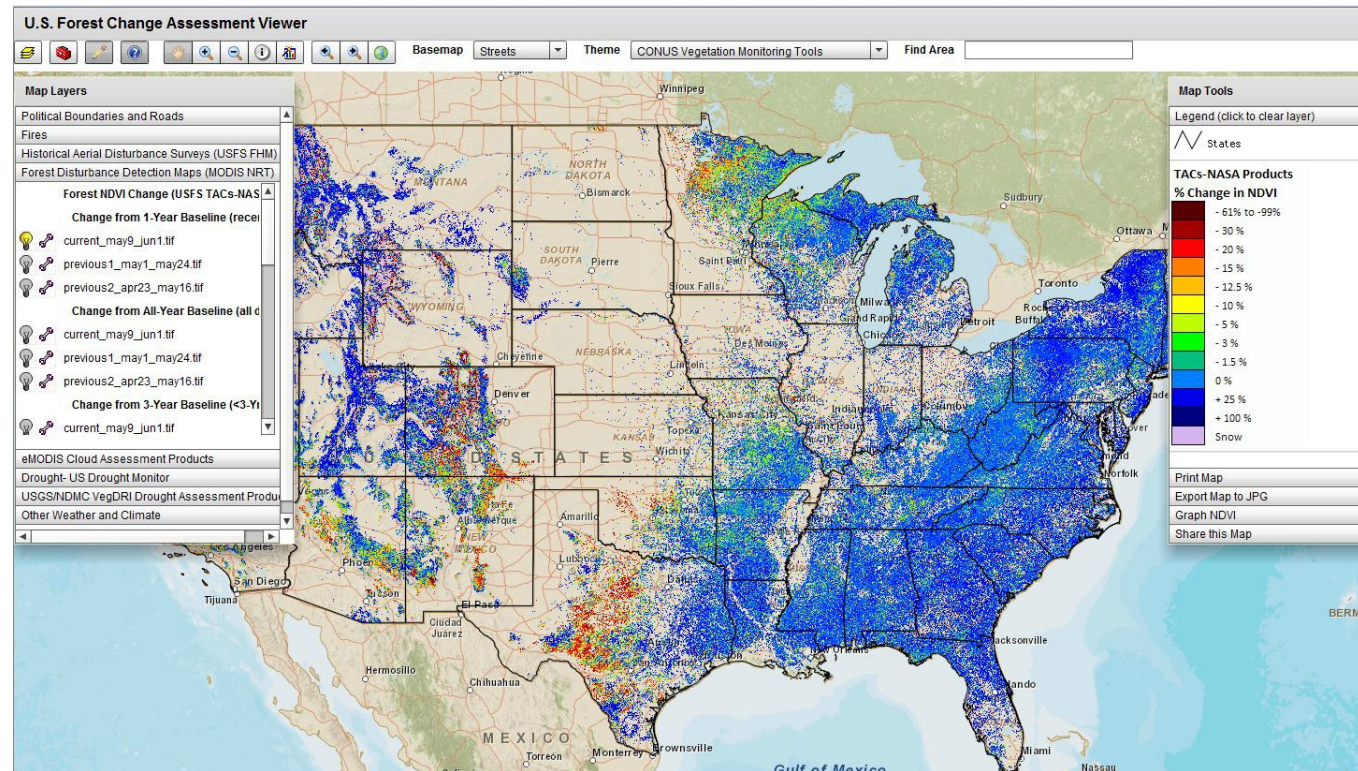
This image shows the change in NDVI between the May 9 to June 1 time frame and the 1-year baseline
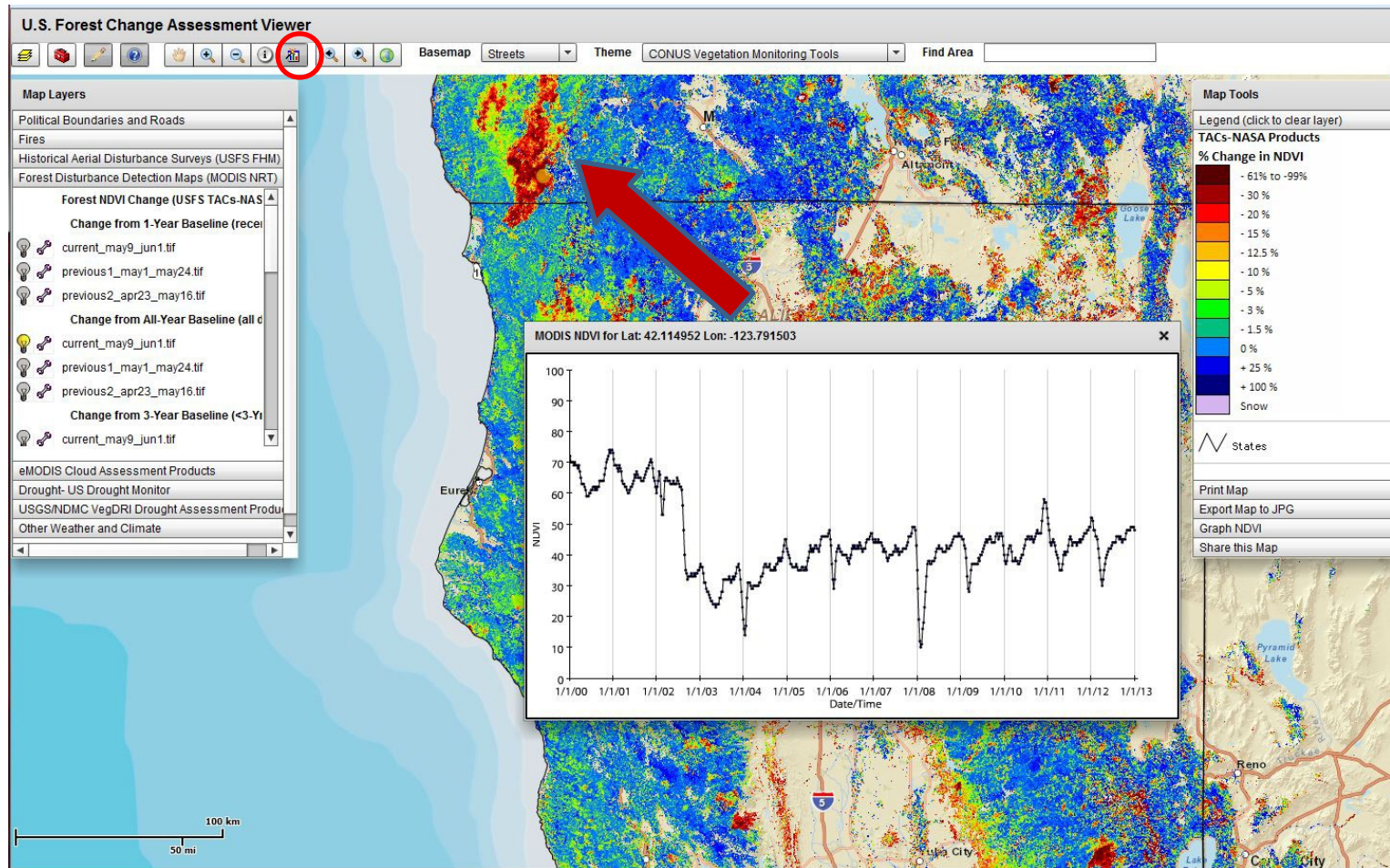
U.S. Forest Change Assessment Viewer: Forest Change Products

Additional products:

- ➢ "Early Detect" change from previous year

- ➢ Seasonally-adjusted change – Excludes normal seasonal fluctuations in green-up and brown down.
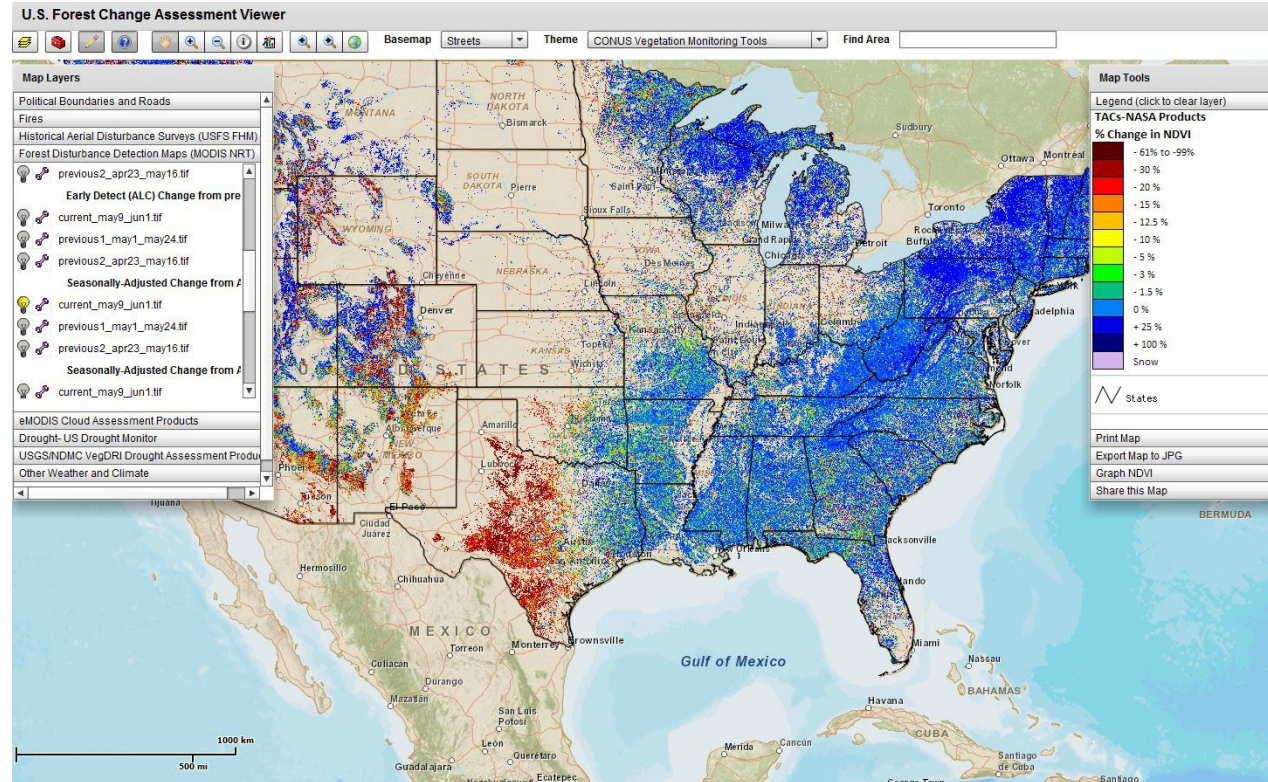
This image shows seasonally-adjusted change for the time period May 9-June 1, 2014.
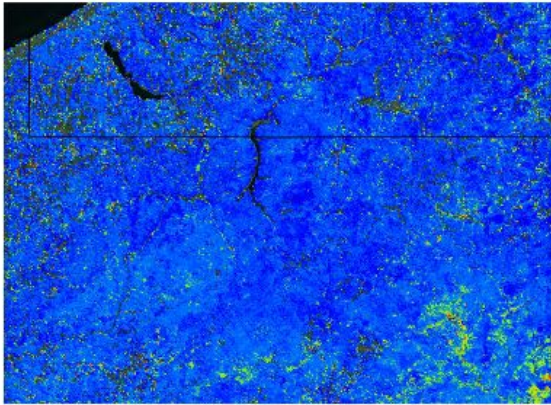
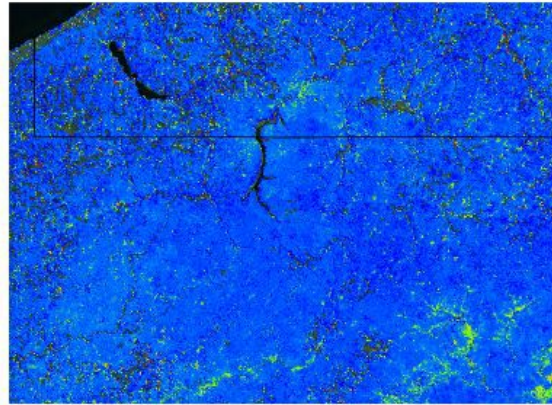# U.S. Forest Change Assessment Viewer: Basic Phenology Products

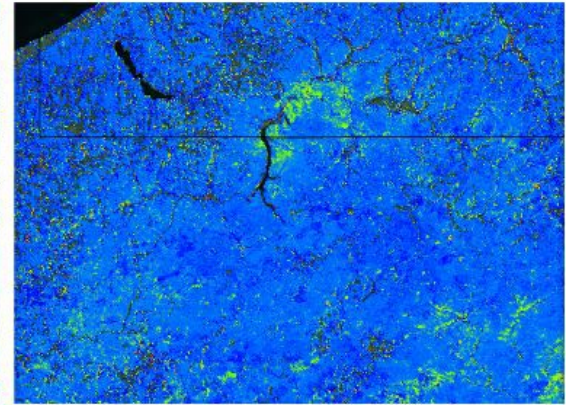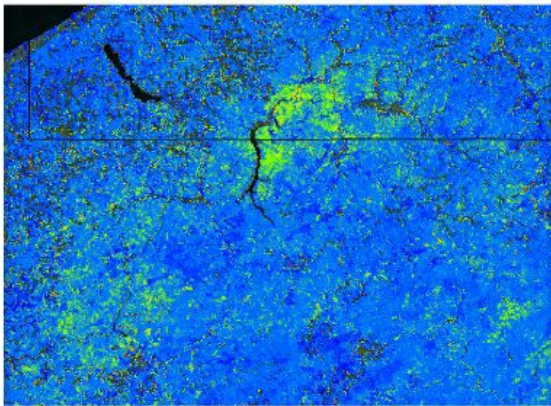# Use of ForWarn: 2013 Gypsy Moth Defoliation in New York and Pennsylvania

Change Detection Web Portal:
Global Forest Change

http://earthenginepartners.appspot.com/science-2013-global-forest
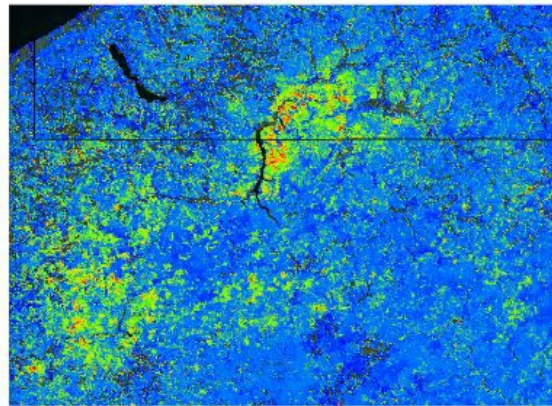
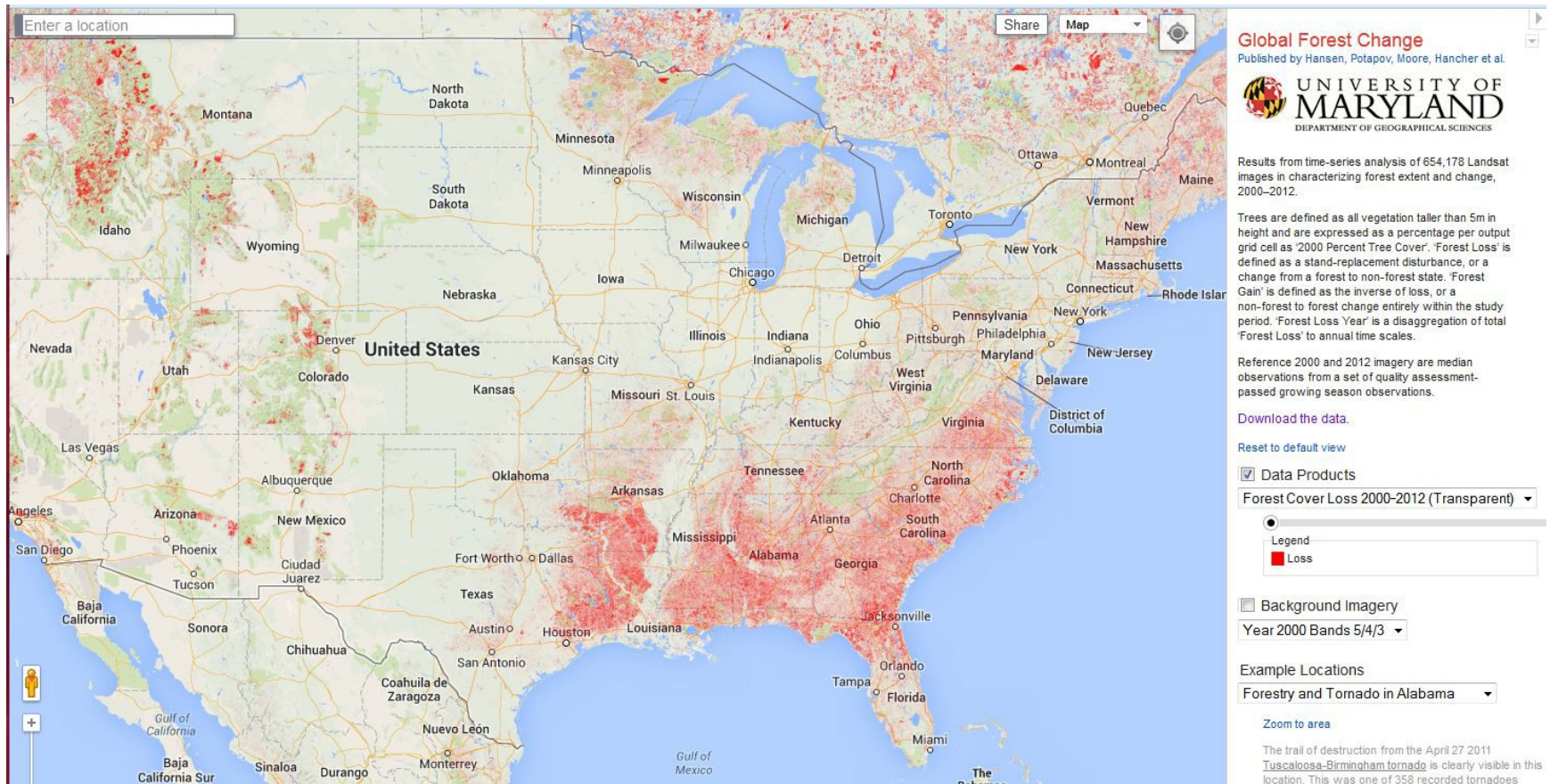*This image shows forest extent (green) and forest loss (red)*
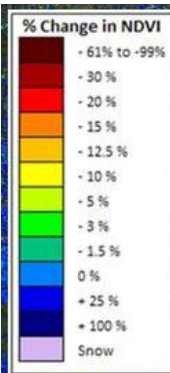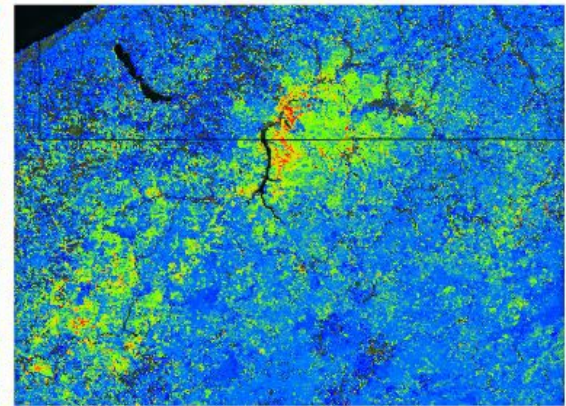
Global Forest Change
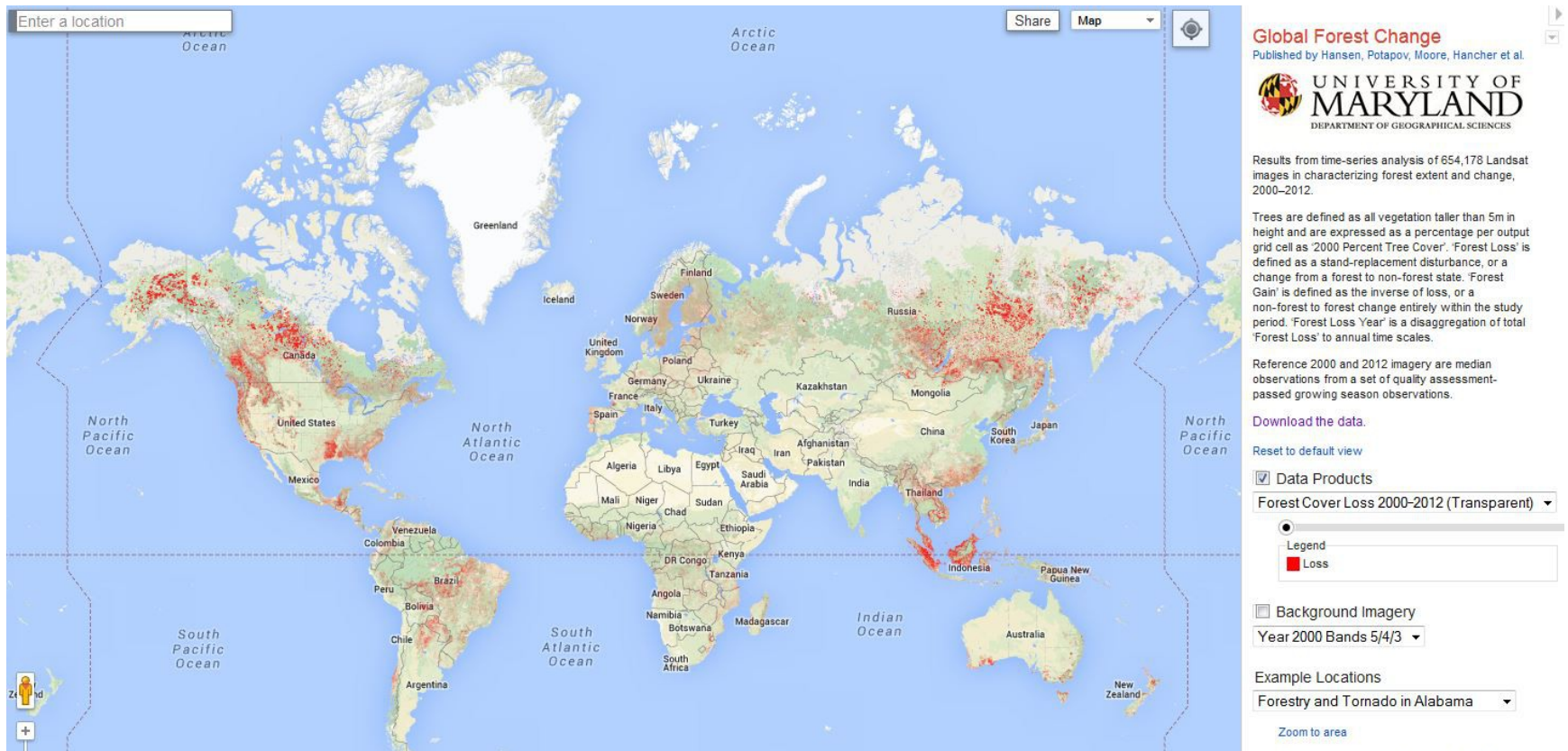
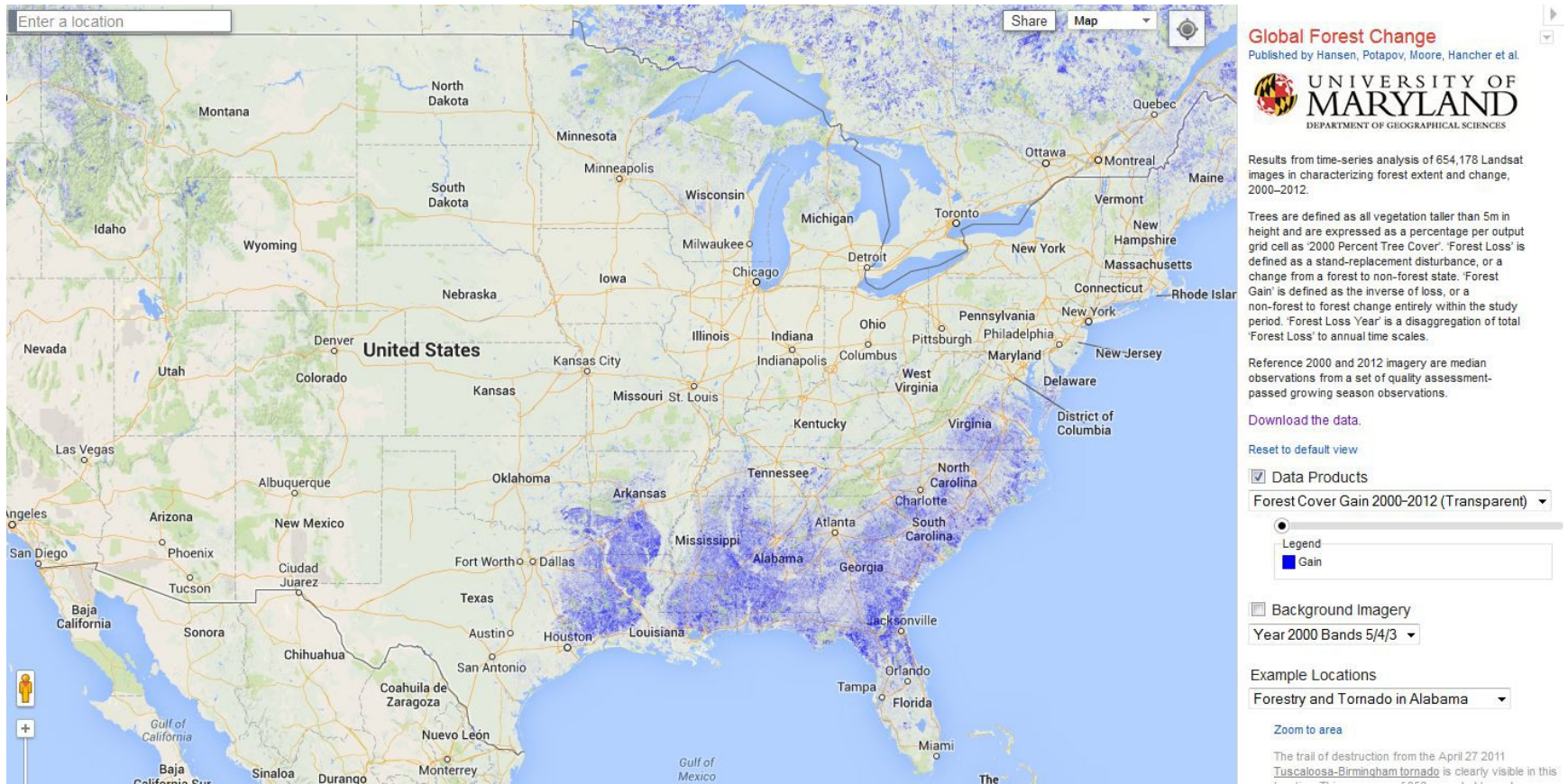*This image shows forest loss between 2000-2012*

Global Forest Change
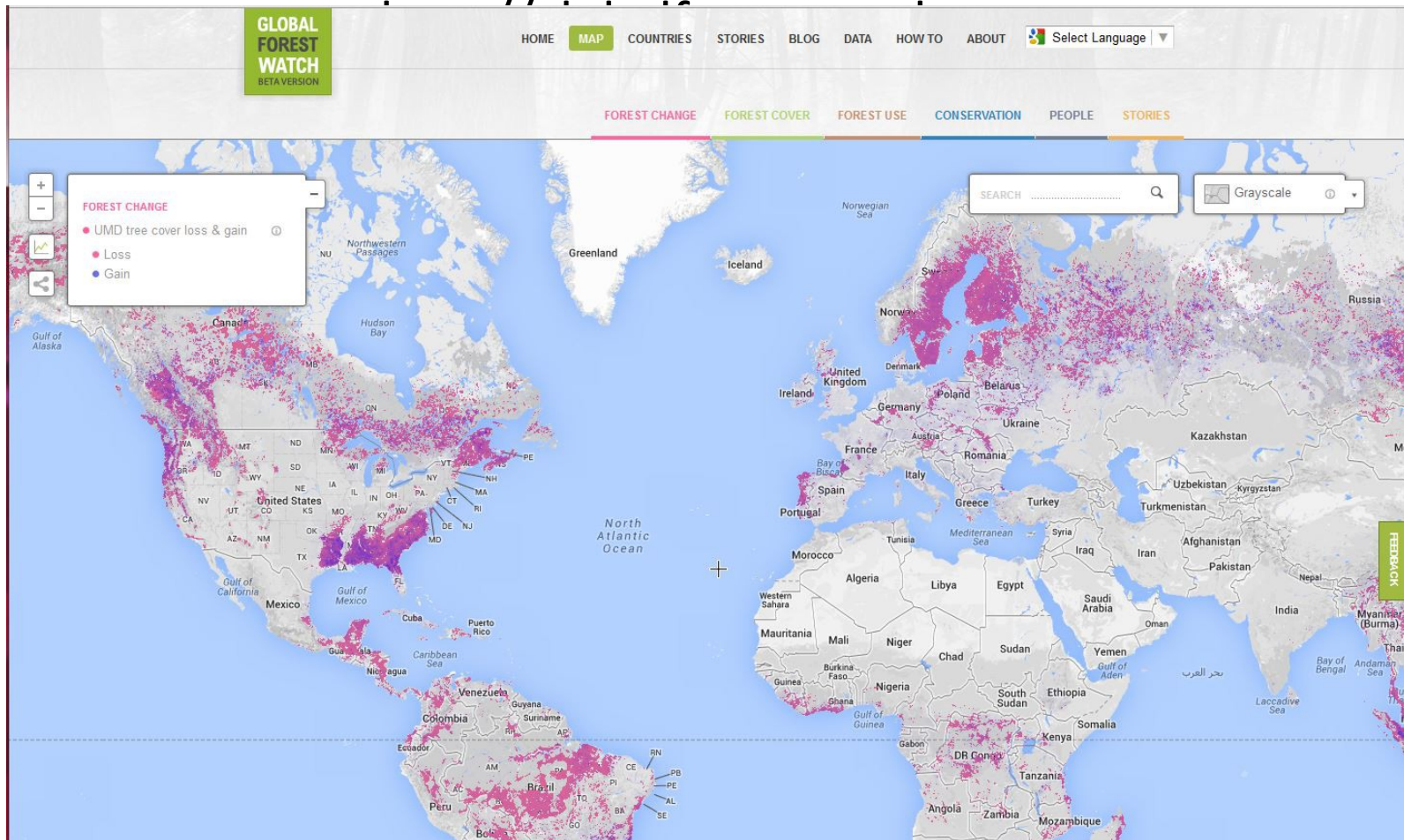

Forest loss between 2000-2012

Global Forest Change

Forest gain from 2000-2012

Change Detection Web Portal: Global Forest Watch

Next: Global Forest Watch Live demo

Coming up next week!

Week 5 (17 June 2014)

Live demonstrations of data access and visualization web portals

Thank You!

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